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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/069,031	07/05/2002	Johannes Kaeppeler	24230PCT/US	7779

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EXAMINER	
ANDERSON, MATTHEW A	
ART UNIT	**PAPER NUMBER**
1722	

DATE MAILED: 04/07/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/069,031	KAEPPELER ET AL.	
	Examiner	Art Unit	
	Matthew A. Anderson	1765	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *13 September 2004*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *40-66* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *40-66* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *05 July 2002* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☒ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Claim Rejections - 35 USC § 103

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

2. This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

3. Claims 40-47, 49, 50-52, 54, 56-57, 60-63 are rejected under 35 U.S.C. 103(a) as being unpatentable over Crawley et al. (US 5,871,586) in view of Burk (US 5,788,777).

Crawley et al discloses an apparatus described as useable in the MOCVD epitaxial deposition of semiconductor materials including GaAs, GaAlAs, InP, InGaAlP, SiC, GaN and ZnSe (see col. 1 lines 1-35). The description of the first embodiment of

the apparatus is given in col. 2 as: (1) a reaction chamber for accommodating a heated substrate, (2) two chambers for the introduction of process gas onto the hot substrate, (3) multiple cooled conduits for transfer of the process gas to the reaction chamber so that mixing of the precursors occurs in the reaction chamber in the presence of the substrate to form a deposit of the material on the substrate (col. 2 line 40-45). Fig. 2 shows the apparatus. The description thereof (starting col. 3 line 35) discloses a heating system including induction heating, radiation heating, or resistance heating "as desired". This least suggests actively heated walls. The heating system heats the substrate holder (i.e. the susceptor) which in turn heats the substrate. The substrate holder is rotatable about the longitudinal axis of the tubular reactor (col. 3 lines 65+). Removal of the exhaust gas occurs at the bottom of the chamber between the liner (6) and the susceptor support (3). Reduced pressure is disclosed in col. 3 lines 50-55.

Crawley et al. does not disclose the temperature to which the reactor is heated.

Burk discloses a modified susceptor for epitaxial growth reactors for growing silicon carbide epitaxial layers. The susceptor assembly has multiple substrate holders which are levitated and rotated by inert gas flow (i.e. by gas foil rotation). (Abstract) This susceptor deals with the problems of cracking of the susceptor because higher temperatures (1450'-1700' Celsius) are required for SiC deposition than typical reactor temperature (800'Celsius). (col.1 lines 45-55) Susceptor material is described as "graphite , SiC, or SiC coated graphite, to name a few" in col. 4 lines 10-12.

It would have been obvious to one of ordinary skill in the art at the time of the present invention to combine the apparatus of Crawley et al. with that of Burk because

Burk's susceptor allows operation of Crawley's apparatus without the problem of heat induced susceptor cracking.

In respect to claims 40, it would have been obvious to one of ordinary skill in the art at the time of the present invention to, in a method of epitaxial deposition of a semiconductor such as SiC or GaN by CVD, heat a rotated substrate to approximately 1100 to 1800 degrees Celsius in a flow channel reactor, introduce the process gas just ahead of the substrate, heat the flow channel reactor on all sides, and actively cooling the process gas such that it does not prematurely decompose, because Crawley et al. discloses such a apparatus used in such a manner and Burk et al. discloses the typical temperatures used in such deposition of SiC as 1450-1700 degrees Celsius.

In respect to claim 41, it would have been obvious to one of ordinary skill in the art at the time of the present invention to rotate the substrate holder plate by gas foil rotation because Burk et al. discloses such rotation (abstract).

In respect to claim 42, it would have been obvious to one of ordinary skill in the art at the time of the present invention to use silane and propane as the process gases for such deposition because Burk discloses in col. 2 lines 48-55 and in Fig. 1 such process gases.

In respect to claim 43, it would have been obvious to one of ordinary skill in the art at the time of the present invention to maintain temperature uniformity of the substrate holder because Crawley et al discloses providing this in Col. 6 lines 30-35.

It would have been obvious to one of ordinary skill in the art at the time of the present invention to optimize the growth rate of the SiC layer because such would have

been achieved with only routine experimentation. Additionally, faster growth rates would mean more through put and would be more economically favorable.

In respect to claim 44, to reduce premature reaction of the process gas (i.e. the formation of Si clusters and seeds) because Crawley et al. discloses actively cooling the process gas until it is mixed at the hot substrate.

In respect to claim 45, it would have been obvious to one of ordinary skill in the art at the time of the present invention to optimize the pressure of the deposition because Crawley et al. discloses a reduced pressure and such optimization would have been achieved with only routine experimentation.

In respect to claim 46-47, 49, 56, 62 it would have been obvious to one of ordinary skill in the art at the time of the present invention to form a reaction chamber with cooled gas inlets placed just ahead of the substrate holder (capable of holding a plurality of substrates in a horizontally adjacent manner), a symmetrically rotatable horizontal substrate holder, a gas outlet, a heater device capable of controlled heating from 1100'C to 1800'C, and a heated wall of the chamber opposite the substrate surfaces, because Crawley et al. discloses such an apparatus for SiC epitaxial deposition and Burk discloses such epitaxial temperature requirements for SiC as from 1450'C to 1700'C.

In respect to claim 50, it would have been obvious to one of ordinary skill in the art at the time of the present invention to use a mechanically driven shaft since Crawley et al. suggests such in Fig. 2 as item (3).

In respect to claims 51-52, it would have been obvious to one of ordinary skill in the art at the time of the present invention to heat the substrate holder controllably (i.e. with a controller) because Crawley et al. discloses in col. 3 lines 44-50 susceptor heating means including induction (i.e. high frequency), radiation (i.e. lamp) or resistance heating as desired.

In respect to claims 54, 60, it would have been obvious to one of ordinary skill in the art at the time of the present invention to use a highly conductive material for the susceptor and the reactor, and to install the boundary wall in a fixed position because Burk discloses a graphite susceptor, the susceptor was known to transfer heat to the substrate effectively, and the boundary wall was shown in Fig. 2 of Crawley as fixed at a defined distance from the substrate-side boundary of the flow channel.

In respect to claim 61, it would have been obvious to one of ordinary skill in the art at the time of the present invention to have the boundary wall actively coolable by a gaseous medium because Fig. 2 of Crawley shows a purge flow gas between the boundary wall and the heated flow channel.

In respect to claim 63, it would have been obvious to one of ordinary skill in the art at the time of the present invention to use graphite as the conductive material because Burk uses graphite as the susceptor material and the material was know to effectively transfer heat to the substrate.

4. Claim 48, 55, 58-59, 64-66 are rejected under 35 U.S.C. 103(a) as being unpatentable over Crawley et al. in view of Burk as applied to claims 40-47, 49, 50-52, 54, 56-57, 60-63 above, and further in view of Flynn et al. (US 6,447, 604 B1).

Crawley et al. combined is described above.

Crawley et al. does not disclose a coating on the boundary walls, the substrate plate or the substrate holder as having a continuous inert coating such as TaC, or NbC.

Flynn et al. discloses a method of reducing defects and thereby improving the quality of epitaxial layers formed in a reactor by vapor phase epitaxy (i.e. CVD). Process conditions include temperature of from 500 to 1250 degrees Celsius and pressure of from 1 to 1000 torr. Materials grown include AlN and GaN. (abstract) In col. 7 lines 50-60, disclosure of TaC and NbC inert coatings are made on the susceptor and reactor parts.

It would have been obvious to one of ordinary skill in the art at the time of the present invention to combine the inert coating of Flynn et al. with Crawley combined in a deposition reactor for depositing GaN and AlN because Flynn et al. discloses such coatings as helping reduce the defects present in GaN. This is motivation for the sue of the coatings.

In respect to claim 48, It would have been obvious to one of ordinary skill in the art at the time of the present invention to coat the reactor parts of a reactor as claimed with TaC and NbC because such were disclosed by Flynn et al as contributing to improved quality of epitaxial films produced in such a coated reactor.

In respect to claims 55, 64, it would have been obvious to one of ordinary skill in the art at the time of the present invention to coat the reactor parts with an inert coating (e.g. TaC or NbC) able to stand high temperature and resist chemical etching because such coating were known to improve epitaxial film quality and TaC and NbC were described as inert.

In respect to claims 58-59, it would have been obvious to one of ordinary skill in the art at the time of the present invention to use different inert materials in the outlet segments and on the substrate holder because at least two inert materials where known (TaC and NbC) and described as alternatives. Those of ordinary skill would have expected different materials to have different intrinsic properties.

In respect to claim 65, it would have been obvious to one of ordinary skill in the art at the time of the present invention to use the known reactor materials of TaC coated graphite and SiC-coated graphite because these were known in the art to function in CVD reactors.

In respect to claim 66, it would have been obvious to one of ordinary skill in the art at the time of the present invention to use Ta or Mo in components on the susceptor because Burk et al. discloses the use of Ta and Mo as components on the susceptor (col. 4, lines 20-25).

5. Claim 53 is rejected under 35 U.S.C. 103(a) as being unpatentable over Crawley et al. in view of Burk as applied to claims 40-47, 49, 50-52, 54, 56-57, 60-63 above, and further in view of Hirata et al. I. (US 4,542,273).

Crawley et al. combined is described above.

Crawley et al. does not disclose a boundary wall heating by two separate circuits.

Hirata et al. discloses inductive heating with multiple circuits.

It would have been obvious to one of ordinary skill in the art at the time of the present invention to combine the references because Crawley et al. discloses induction heating and Hirata et al. discloses multiple (i.e. two or more) induction circuits in an apparatus using such heating.

It would have been obvious to one of ordinary skill in the art at the time of the present invention to include multiple heating circuits in an apparatus such as the claimed one because such heating circuit were well known and described as less costly. (col. 1 lines 10-25).

Response to Arguments

6. Applicant's arguments filed 9/13/2004 have been fully considered but they are not persuasive.

The argument that the Combined references of Crawley and Burke et al. do not suggest a flow reactor with heating on all sides is not convincing. The heating suggested by Crawley et al. includes induction heating, radiation heating and resistance heating. Further, there is suggestion to modify the heating to achieve desired results. Induction and radiation heating would at least suggest heating the wall regions in the reactor. In col. 4, rotation is suggested as useful for ensuring the uniformity of the

thickness and composition of the material deposited. This suggests the desirability of uniformity of the parameters of deposition in the chamber.

In respect to claim 1, the applicant's argument that the references fail to show certain features of applicant's invention are not persuasive in that it is noted that the feature upon which applicant relies (i.e., the thermal gradient) is not recited in the rejected claim(s). Although the claims are interpreted in light of the specification, limitations from the specification are not read into the claims. See *In re Van Geuns*, 988 F.2d 1181, 26 USPQ2d 1057 (Fed. Cir. 1993).

Conclusion

7. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Matthew A. Anderson whose telephone number is (571) 272-1459. The examiner can normally be reached on M-F, 8:30-5.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Benjamin Utech can be reached on (571) 272-1137. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

MAA
April 4, 2005